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AGRICULTURAL MEMORANDUM NO 596

An annotated bibliography on the effects of mulching on plant climate, with some comments on consequent yields.

Part VIII - Effects on weed suppression

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Previous parts of this bibliography were issued as Agricultural Memoranda Nos 392, 423, 523, 548, 554 and 583.

8.1 NO SPECIFIC CROP

Organic mulches

Schaller (2) reports that the weed population in a crop stand was increased under mulch tillage compared with ploughing, while McCalla (3) stresses the increased difficulty of weed control in stubble mulch farming. Meanwhile Pflug (7) reports from Czechoslovakia, that the application of a peat mulch to arable soil, markedly decreased the weed population, particularly the annual weeds. Hamner (1) however advocates an economical method of paper mulching. Waste newspapers are soaked and then shredded and placed around the growing crop. The mulch dries out and hardens on the soil surface, thus preventing weed growth.

Non-organic mulches

A porous mulch, comprising pea-size gravel held together with a small amount of mortar so that the pores between were left unfilled, was used by Richards (6) to suppress weeds and to minimise their control. Pusztai (4) found that a plastic foil also decreased weediness.

The effect of the transparency of the cover on weeds has been studied by Revut (5) and Abrosimova (8). They show that weed seedling emergence was decreased by 55% when transparency was reduced to 10%, and by much more when the transparency was reduced from 10% to 2%.

1. HAMNER C L and RAI G S. 1954. A new method of weed control. Agric Chemls., 9(10): 65, 117.

2. SCHALLER F W and EVANS D D. 1954. Some effects of mulch tillage. Agric Engng. Mich., 35, 731-4, 736, 27 refs.

3. McCALLA T M, ARMY T J and WHITFIELD C J. 1962. Stubble-mulch farming. J Soil Wat. Conserv., 17 No 5, 204-8, 8 refs.

4. PUSZTAI A, ERDÖS L and PLETSER J. 1964. Recent results on mulching with plastic foils. I. (in Hungarian). Agrokém. Talajt. 13, 231-42.

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5. REVUT I B and ABROSIMOVA L N. 1965. Effect of intensity of illumination of the soil surface on emergence of weed seedlings and biological activity of the soil. (in Russian). Dokl. vses. Akad. sel'-khoz. Nauk. No 12, 15-20.

6. RICHARDS S J. 1965. Porous block mulch for ornamental plantings. Calif. Agric. 19, No 12, 12-4.

7. PFLUG J and KOSTELANSKÝ F. 1967. Soil mulching assessment in view of weed occurrence. (in Czech) Sb. vys. Šk. zeměd. Brně(A), 15, No 2, 263-70, 15 refs.

8. ABROSIMOVA L N and REVUT I B. 1968. Effect of the transparency of a soil cover on the number of weed seedlings. (in Russian). Sb. Trud. agron. Fiz. No 14. 144-52.

8.2 TEMPERATE TREE FRUITS

The clover-grass mulch strip system of orchard soil management in Germany is shown by Kramer (3) to have the additional advantage of controlling weeds.

Harkness (1) in USA and Baskett (2) in Australia both used black and other opaque plastic mulches to obtain weed control, the former with avocadoes and the latter with young fruit trees.

1. HARKNESS R W and RUEHLE G D. 1959. Mulching tests on young avocado trees planted in old grove land. A. R. Fla. agric. Exp. Stats., 1957-58, p 352.

2. BASKETT W J. 1960. Polythene plastic sheeting for mulching fruit trees and vegetables. J. Agric. S. Aust. 64: 149.

3. KRAMER S AND STÖRTZER M. 1965. The clover-grass mulch strip method. (in German). Obstbau, Berlin, 5: 123-5.

8.3 TEMPERATE HORTICULTURE AND SOFT FRUIT, VEGETABLES AND FLOWERS

Organic mulches

Mulching with straw is shown by Cikalov (19) to control weeds among rose bushes, better than either hoeing or digging. Rasmussen (28) also achieved some weed control using mulches of sphagnum, straw and chaff on tulips. Surlekov (31) used a mulch of 8 tonnes of straw/hectare on field grown cucumbers and found that weed growth was suppressed. Robinson (34) compared the effects of a straw mulch on gooseberries with a complete herbicide programme.

Evelyn (3) prevented weed growth by using mulches of groundnut shells, while Hoogendoorn (16) reduced weed growth in the nursery using a mulch of servall (shredded sugar cane stalks), finely broken up in a corn cutter. Salinger (10) in New Zealand, kept small plots of gladiolus free of weeds by mulching with sawdust but Bielka (14) found that there was no effect on weed growth when mulching vegetables with stable manure in Germany.

Cover crops and mulches in Ceylon did not control weeds according to Kirinde (5), but Hamner (1) found that the use of soaked and then shredded newspaper, spread as a mulch over a radius of 30 cms around each plant, resulted in weed free plots of tomato and cabbage in USA.

Non-organic mulches

Black polythene film used as a mulch on strawberries, is shown to be very effective in controlling weeds, according to Brooks (8) and Voth (13) in USA, Pastac (11) in France and Cox (26) in Australia. Black film has also been used successfully to prevent weeds with other crops. Emmert (2) with early vegetables and Honma (9) with asparagas report from USA, Mostert (30) used outdoor melon plants in Holland, Irizarry (36) used tomato plants in Puerto Rico while Porter (12) used bush fruits in New Zealand and Elia (27) used gladiolus corms in Italy.

Thompson (17) reports that an opaque mulch suppressed weeds with strawberries in USA, while Marecek (18) obtained similar results in Czechoslovakia with a range of vegetables using a transparent polythene film.

A comparison between clear and black polythene mulches was made in USA by Eplee (21) who found that they both gave similar weed control when used with tomatoes but Nylund (23) claims that in another American comparison the clear film did not control weeds. Alpi (33) in Italy also found that a clear film resulted in a marked growth of weeds, whereas a black film gave effective control.

Kasahara (29) conducted tests using black, green, yellow, white and clear vinyl and polythene films. He reports that mulching with black film inhibited the germination and the growth of weeds completely and the green film also gave satisfactory weed control. The polythene film was cheaper than the vinyl and seemed to be satisfactory. In another comparison in France, Acquier (32) favoured smoked grey polythene film because it gave more effective weed suppression than either a clear film or a black petroleum mulch.

Collin (20) in USA attributed much of the benefit from mulching vegetable crops with black polythene to its effective weed control in comparison with a petroleum mulch which failed to give any weed control. Voth (35) also found that weeds readily grew through a petroleum resin mulch and he preferred a clear polythene mulch to black or grey because of its better weed suppression when used with strawberries in California. Wiggans (25) reports that an asphalt mulch alone encouraged weed growth but the combination of an asphalt or resin mulch with a herbicide gave fairly good weed control.

Krylov (6) studied the effectiveness of a paper mulch produced from sulphite kraft impreganated with different combinations of herbicides. After sowing weed seeds, the ground was covered with this paper, and carrot, beetroot and radish seeds were sown into perforations of various sizes. Crop germination was unaffected provided the diameter of the holes exceeded 10 mm, but weed emergence was retarded for 60 days. Muratova (22), also in Russia raised onion sets with a mulch of paper impregnated with bitumin and other chemicals and thus reduced weed populations.

Mixed mulch comparisons

A comparison between mulches of black plastic film and sawdust has been studied by Andrews (4) with land cress in Canada, who shows that the black plastic was more effective in controlling weeds when used to cover the soil 13 or 27 days before and for 5 days after sowing. Porter (12) with strawberries in New Zealand however, found that both mulches eliminated the necessity for further weed control.

Gopalkrishna (15) in India, found that black polythene film was a more effective mulching material for suppressing weed growth than was sawdust, which was slightly better than a mulch of dried leaves.

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3. EVELYN S H. 1956. The Swaziland Irrigation Scheme. 2 Groundnut-shell-mulching of fallow land. World Crops. 8, No 2, 68-71, 2 refs.

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5. KIRINDE S T W. 1957. Weed control in dry land farming. Trop. Agriculturist, 113, No 2, 131-47, 2 refs.

6. KRYLOV S V. 1957. Chemically treated paper mulch for seed beds. (in Russian). Dokl. Mosk. s-h Akad. Timirjazeva, No. 29, 69-73.

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8. BROOKS A N. 1958. Strawberry Investigations Laboratory. A. R. Fla. agric. Exp. stat, 1957-58, 394-6

9. HONMA S and McARDLE F J. 1958. Black plastic for white spear production. Amer. Veg. Gr. 6(5): 45.

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11. PASTAC J P. 1959. New methods in agriculture: the use of plastic materials. (in French), C R Acad. Agric. Fr. 45, 176-8.

12. PORTER L A. 1959. Strawberries grown without soil cultivation. N.Z. J. Agric. 98: 265-6.

13. VOTH V and BRINGHURST R S. 1959. Polyethylene over strawberries. Calif Agric. 13(5), 5, 14.

14. BIELKA R. 1960. Yield increases by soil covering in the field production of vegetables. (in German). Dtsch. Gartenb , 7, 98-100, 4 refs.

15. GOPALKRISHNA N, DEO P V and BHAVNANI J K. 1960. Influence of mulch on growth and yield of Bhokari grape. Hort. Advance, 4, 83-8, 10 refs.

16. HOOGENDOORN C. 1960. Use of mulches in the nursery. Proc. 10th ann. Mtg. Plant Prop Soc. 111-4.

17. THOMPSON B D. 1960. Response of strawberries to mulching with plastic. Proc. Fla. St. Hort. Soc. 1959, 72, 179-85, 13 refs.

18. MAREČEK F and TREFNA E. 1961. Mulching vegetables with polythene film. (in Czech). Rostlinná Výroba, 7, 663-78, 23 refs.

19. ČIKALOV P M. 1962. The effect of mulching on the development of the essential oil-bearing rose. (in Russian). Vestn. sel'sk. Nauki, 7 (11) 127-31, 5 refs.

20. COLLIN G H. 1962. Mulching of vegetable crops. A. R. hort. Exp. Stat. and Prod. Lab. Vineland, 52-6.

21. EPLEE R E, COTTER D J and HERRON J W. 1962. The use of clear plastic mulch with herbicides in tomato production. Proc. 19th N. cent. Weed Control Conf. 23-4.

22. MURATOVA E V and LEBEDEVA E A. 1962. Raising onion sets with paper mulch to protect the seedlings. (in Russian). Dokl. mosk. sel'-hoz. Akad, K.A. Timirjazeva, No 77, 331-5.

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8.4 FORESTRY

Organic mulches

In weed-suppression experiments in England, Jobling (3) reports that mulches of cut vegetation or straw laid 15 or 30 cm deep to a radius of not less than 60 cm round each tree and maintained for 3 years, was more effective than mounding or soil cultivation. Mullin (9) meanwhile in Canada found that a sawdust mulch gave better weed control than a mulch of rye straw.

Non-organic mulches

The results of comparative trials in Czechoslovakia are presented by Vasicek (11) which shows that the use of a black polythene mulch was a more economical and efficient method of weed control on nursery seedbeds than the use of herbicides. Blanke (1) in Germany also describes promising results after using a black polythene film 20 cm wide for 2 years. Very little weeding was required.

The use of 12.5 cm strips of light coloured PVC to control weeds is particularly recommended for old nurseries or stiff soils by Seigel (7) after 3 years experience, but Schindler (10), also in Germany, found that there was no significant reduction in weed growth when a plastic foil was used between 3 year old transplants in a dry summer, and he does not recommend its use. Kolster (15) in Holland, also does not recommend the use of plastic sheeting for weed control on the grounds of economy.

Novotny (13) obtained only moderately promising results using sheets of clear polythene as mulches in planting trials, and he concludes that much more effective weed control would be obtained with mulches of black polythene film.

Tests of weed suppressing mulches of black polythene sheeting, sisalkraft paper, and foil, as used in the English horticultural industry, were unpromising according to Faulkner (2). He concludes that they are unlikely to have a future in forest nursery practice in view of the difficulty of handling and poor weed suppression achieved. However, Kokkonen (5) in Finland and Cozzo (12) in Argentina obtained weed control under mulch collars around new plantings except perhaps against dense weed growth. The materials used were different types of kraft paper, tarred felt, aluminium foil or black polythene and the collars were made from squares ranging in size from 20 x 20 to 60 x 60 cm.

Mixed mulch comparisons

Laber (6) discusses experiments in a Bavarian nursery which showed that a peat mulch 3 cm deep on a seedbed previously treated with simazine was not only cheaper than a covering of black polythene film on an untreated bed but it also gave better weed control. Zeyher (8) compares the cost of suppressing weeds by mechanical means, by covering with plastic film, peat mull or leaves, and by chemicals, and the relative costs of materials and labour for these methods in Germany. He concludes that mulching with peat mull was particularly advantageous.

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2. FAULKNER R and ALDHOUS J R. 1960. Nursery investigations. Extr. from Rep. For. Res. For. Comm., Lond. 1958/59, 18-32, 2 refs.

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4. STRANSKY J J. 1961. Weed control, soil moisture, and Loblolly Pine Seedling behaviour. J. For. 59(4), 282-4, 289-90.

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6. LABER B. 1964. Plastic film or peat mulches in the nursery? (in German). Forst-u. Holzw. 19(5), 90-1.

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11. VAŠICEK F. 1966. The effect of polythene film on the production of Pinus sylvestris seedlings. (in Czech). Lesn. Práce, 45(5), 220-3.

12. COZZO D. 1967. Mulching round recently planted forest trees. (in Spanish). Rev. for. argent. 11(3), 79-83, 2 refs.

13. NOVOTNÝ V. 1967. Do polythene films help in afforestation? (in Czech). Lesn. Práce. 46(3), 111-3.

14. BOWERSOX T W and WARD W W. 1968. Juvenile growth and yield of hybrid Poplar clone NE-388. Res. Briefs Sch. For. Resour. Pa. St. Univ. 3(1), 2-6.

15. KOLSTER H W. 1969. Plastic sheeting in weed control in Poplar plantations. (in Dutch). Populier, Wageningen 6(2), 25-31.

8.5 GRASSES AND CEREALS

The application of a straw mulch together with atrazine to maize trials in Germany, is shown by Samiy (3) to have controlled both annual and perennial weeds. Undersowing with yellow clover did not however remove weeds.

Soil shown with winter rye in Russia, was covered with tar paper or polyethylene sheet either directly on the soil or mounted 5 cm above the surface and the results are given by Goncharov (1). When the cover and weeds were removed, the

number of weeds that appeared subsequently were greater on covered plots with previously fewer weeds, than on covered plots with previously more weeds.

An American paper (2) suggests that the incorporation of a pre-emergence herbicide to a petroleum mulch should control weeds, when sprayed in a continuous black film over a number of crops including grasses and cereals.

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3. SAMIY H. 1964. The effects of undersowing, mulching and weed-killers on maize production. (in German). Bayer. landw. Jb. 41, 798-813, 17 refs.

8.6 TROPICAL AND SUB-TROPICAL CROPS

Organic mulches

The usefulness of a mulch of trash (dried cane leaves) on fields of sugar cane has often been studied. In India. Mathur (4 and 13) and Rajamanickam (14) suppressed weed growth and reduced costs of production using trash mulches from 5 to 30 cm thick, while from Taiwan, Chang (5) also reports reduced weeding costs but he stresses the need for effective rat control measures where a trash mulch is used.

Mulches of banana leaves, parchment or grass applied to plots of young coffee are shown by Alférez (15) to considerably reduce weed growth, and similar results were obtained by Uribe (12) using mulches of sawdust or rice-hulls on oil-palm nurseries. The possibility that mulches may encourage the multiplication of rodents is also discussed.

Non-organic mulches

Mulching the sugar cane crop in India with a black polyethylene film is shown by Babu (7) to offer little advantage except in respect of weed suppression. Panje (11) meanwhile, compared a black polyethylene mulch with a translucent one and found that the latter promoted a strong growth of weeds.

Black polyethylene mulches were also used to give weed control on tobacco in USA by Smith (3); on cotton and sisal in Africa by Bennett (16) and Hopkinson (18); and also on bananas in Tenerife by Garcia (17).

In a comparison between various types and thicknesses of polyethylene and vinyl-plastic sheets in citrus nurseries in USA, Cahoon (8) shows that a black plastic mulch controlled the growth of weeds best. Natural and aluminium-impregnated polyethylene were not sufficiently durable for nursery use.

Jazykov (9) in Russia, made a study of the effectiveness of drilling cotton under mulches of 15 cm wide strips of paper impregnated with bitumen or naphthenate. He found that seeds of annual weeds germinated and died under the paper, while perennial weeds grew at the edge of the paper strips, where they were easily controlled by cultivation.

Mixed mulch comparisons

In Hawaii, a mulch of coffee parchment, flat stones, or grass is used to suppress weeds in coffee and Robinson (1) includes a graph to show the influence of mulches on the cost of weed control. On a coffee nursery in Kenya however, a petroleum emulsion sprayed onto the soil to give a black rain-proof film, was found by Blore (10) to encourage weed growth, whereas a mulch of Napier grass suppressed weeds.

In French Guinea pineapple plantations, inter row weed control is most successfully carried out by spraying with diuron, and certain grasses cannot be controlled unless destroyed before planting the crop. However, Py (2) shows that the weeds in double rows are controlled by mulching with either bituminized paper, opaque plastic sheets or straw and the mulching can be carried out over the whole area at planting time.

Lerche (6) describes trials in Kenya in which sisal was grown under the following conditions: (a) planted on bare soil, (b) planted on soil covered with 50 tonnes of sisal waste per hectare, (c) planted through a strip of black polythene film 180 cm wide, and (d) as (c), but with 50 tonnes of sisal waste per hectare on the soil surface. No weed growth was observed around plants grown under polythene during the first year of the trial.

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2. PY C. 1959. Weed control in pineapple plantations. (in French). Fruits d'Outre Mer, 14, 247-61, 291-9, 329-40, 369-87, 423-30, 53 refs.

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14. RAJAMANICKAM D and EKAMBARAM C. 1965. Trash mulch in cane culture at Cuddalore. Indian Sugar 14, 751-6, 7 refs.

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18. HOPKINSON D. 1968. Experiments on mulching sisal with black polythene in Tanganyika. Expl. Agric. 4, 143-50.

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